A review of air pollution impact on subjective well-being: Survey versus visual psychophysics

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ABSTRACT

Air pollution is a worldwide environmental and health issue, especially in major developing countries. A recent World Health Organization report shows about 3 million deaths in the world in 2012 are due to ambient air pollution and China and India are the countries with the most severe challenge. Air pollution influences people's thought and experience of their lives directly by visual perceptions. This reduces people's subjective well-being (SWB) to a significant degree. Empirical researchers have made efforts to examine how self-reported well-being varies with air quality typically by survey method - matching SWB data with monitored air pollution data. Their findings show NO_2, particles, lead, SO_2 and O_3 have significant negative impact on SWB. However, it is very hard to match air pollution characteristics from monitor stations with each respondent's state of SWB at the moment a survey is conducted. Also it is very hard to find the detailed trend impact from only air pollution factor on SWB. This review illustrates the features and limitations of previous survey studies on quantifying the effects of air pollution on subjective well-being. This review further displays the progress of psychophysics and its application in landscape and air quality research. We propose using psychophysics application to quantify air pollution impact on SWB.

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1. Introduction

Air pollution is a worldwide environmental and health issue, especially in major developing countries. According to World Health Organization (WHO), in the year of 2012, ambient air pollution (AAP) caused 3 million deaths within the world and about 87% of these deaths occur in low- and middle-income countries (WHO, 2016). The most deaths came from the low- and middle-income countries of WHO Western Pacific and South East Asian with 1.1 and 0.79 million respectively. China and India are the countries with the most contribution to the figures and also they are the two countries with the most deaths globally (Liu and Liu, 2011; WHO, 2016). The other low- and middle-income countries and regions share the burden with 0.68 million. The remaining deaths occur in high-income countries of Europe, the Americas, Western Pacific, and Eastern Mediterranean, which are about 0.38 million (WHO, 2016). As China and India are planning for and

experiencing rapid urbanization, the air pollution situation will continue to deteriorate.

Smoggy days can impact people's visual perception directly. Subjective well-being (SWB) belongs to a perceptual domain and involves how people think about and experience their lives. In addition, SWB includes different evaluations that individuals' make regarding their lives (Diener, 1984, 2006) that cover the events happening to their bodies and minds and the circumstances in which they live. Rather than conforming to external standards, assessments of SWB are based on an individual's own chosen criteria. Policy-makers are likely to consider SWB in planning and assessing the impact of policy decisions. As a unique example, the Asian nation of Bhutan officially established the Gross National Happiness (GNH) measure by law and replaced the traditional economic policy goal of increased GDP with increased GNH.[1] Subsequently, many western governments have officially introduced or

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[1] Further information can be found under the following link: http://ophi.org.uk/policy/national-policy/gross-national-happiness-index/.
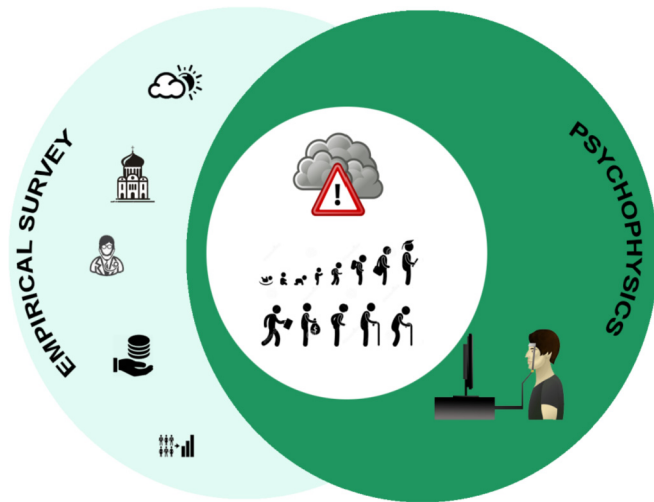
Fig. 1. The structure of this review.

initiated measurements of national happiness or life satisfaction,[2,3] (Schmitt, 2013).

Traditionally, a survey instrument is the tool used to examine air pollution's impact on SWB (one type of people's perception), and it has been widely used by both economists and sociologists. Meanwhile, environmental psychologists have started adopted psychophysical methods to solve environmental issues, including landscape attractiveness and acceptable visual air quality standard. However, psychophysical procedure has never applied to evaluating air pollution impact on SWB. This review work aims to provide a new perspective in measurement of air pollution impact on SWB. Fig. 1 shows the structure of this work. This paper evaluates the performance and limitations of empirical surveys in quantifying air pollution's impact on SWB; reviews certain developments in environmental psychophysics and their application in visual air quality research; proposes to use psychophysical methods to quality air pollution impact on SWB. The remainder of this paper is organized as follows. Section 2 provides a brief introduction of SWB and air pollution. Section 3 illustrates the features and limitations of previous survey studies on quantifying the effects of air pollution on subjective well-being. Section 4 displays the progress of psychophysics and its application in landscape and air quality research. Section 5 summaries the strength and weakness of survey method and proposes an application of visual psychophysical experiments to explain the relation between air pollution and SWB.

2. 2Subjective well-being

For decades, unhappiness has been explored deeply by scientific research, while positive subjective well-being was largely ignored by social scientists prior to the 1970s. In 1973, Psychological Abstracts International began to include happiness as an index term. Since the journal of Social Indicators Research was founded in 1974, many articles have been published that have focused on SWB. Diener (1984) comprehensively reviewed SWB studies, including definitions and measurements.

2.1. Definitions and measurements of SWB

The definitions of well-being can be grouped in three categories. Firstly, researchers represented by Coan (1977) and Tatarkiewicz (1976) have defined well-being by external standard such as virtue or holiness rather than subjective state. They thought that well-being can be obtained by leading a virtuous life. Secondly, social scientists have tried to define well-being by focusing on the factors which leads people believe they are in positive state (Andrews and Withey, 1976; Chekola, 1975; Shin and Johnson, 1978). Thus, happiness is defined as the harmonious state where people's desires and goals are satisfied. The third meaning of happiness emphasizes positive emotional experiences as gaining a superiority of positive affect over negative affect (Bradburn, 1969). SWB emphasizes people's own judgements about themselves and belongs to the second or third well-being definitions categories. The measurement of SWB is often restricted to the measurement of happiness (OECD, 2013). This may be because the notion of SWB is used in research literature as a replace of the term 'happiness'. A definition given by Diener et al. (2006) is commonly identified by research in this field, which is 'Good mental states, including all of the various evaluations, positive and negative, that people make of their lives and the affective reactions of people to their experiences.'

Single-item survey questions frequently constitute measures used by early social scientists. Such measures tend to fall in happiness categories from which scales cannot address all aspects of SWB (Andrews and Withey, 1974; Cantril, 1965; Gurin et al., 1960). Later, multi-item surveys were integrated into scholarly research. During this period, lots of survey scales merged for different purposes of studies and different backgrounds of interviewees. For examples, Lawton (1975) used 17-item scale to measure lonely dissatisfaction, agitation and attitude toward one's aging. Kozma and Stones (1980) used 24 items to measure positive and negative affect and experiences. Researchers have been trying to find general components of SWB, which can be used universally and three general components of SWB were proposed, including life satisfaction judgement, positive affect and negative affect (Andrews and Withey, 1976; Bradburn, 1969; Bryant and Veroff, 1982; Harding, 1982; Zevon and Tellegen, 1982). Bradburn (1969) proposed his global happiness judgement standard Affect Balance Scale by making comparison of people's negative affect with their positive affect. The positive affect may including the proud or pleasant feel and the negative affect may ask about their upset, unhappy or depressed feelings. In a recent study by Kahneman et al. (2004), the SWB for an activity can be measured as the net affect of the average of all positive affects (happy, enjoying themselves) less the average of all negative affects (Frustrated, depressed, worry) and the length of time people spending on it. Nowadays, life satisfaction and affects are both widely studied by researchers.

2.2. Drivers of SWB

Over the last two decades, the importance of SWB has received considerable attention in various fields. The output of SWB measurements is widely implicated in social and health fields (Cohen et al., 2003; Danner et al., 2001; Fujiwara and Campbell, 2011; Ostir et al., 2001; Steptoe et al., 2005). Growing literature in the field of economics has advanced the definition of the factors impacting SWB at the individual level. A predetermined level of happiness unique to each individual's genetics and personality is proposed (Costa et al., 1987; Cummins et al., 2003; Lucas et al., 2003; Lykken and Tellegen, 1996). Easterlin (2003) outlined an improved theory of how life events affect SWB. Life events and personality interact with one another to shape happiness at the

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